



European Sixth Framework Network of Excellence FP6-2004-IST-026854-NoE

Deliverable D1.6

Final Report on Integration, Collaboration and the Visibility of EMANICS

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Document Control

Title: Final Report on Integration, Collaboration and the Visibility of EMANICS
Type: Public
Editor(s): Gabi Dreö Rodosek, Iris Hochstatter
E-mail: gabi.dreo@unibw.de
Author(s): WP1 Partners
Doc ID: D1.6

AMENDMENT HISTORY

Version	Date	Author	Description/Comments
0.1	2008-12-03	Iris Hochstatter	Initial version
0.2	2009-12-15	Joan Serrat	PAOTS activity
0.3	2009-12-30	Björn Stelte	EMIN, WWRM activities
0.4	2010-01-04	Iris Hochstatter	CCP activity, Introduction

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1 Executive Summary

This work package 1 final report summarizes the results of the last year of EMANICS and overall documents the progress of the NoE wrt. integration, collaboration and visibility for the last four years. Thus, one focus of this deliverable is the illustration of EMANICS integration figures and research development. Following last year's positive trend, we demonstrate the high quality of EMANICS events, the increased integration over the years and how collaboration between partners grew. This is enabled by the tools and activities of work package 1.

The open call process executed at the beginning of the third period has led to the funding of five proposals to achieve the objectives of work package 1. Their results are described in greater detail in this deliverable. A map of research activities among EMANICS partners and world-wide has been maintained that provides information about PhD theses, topics of interests of workshops and conferences, and keywords of published papers. The EMANICS common course program has been extended by, first, new teaching material about service management has been developed. Second, an outline for a text book on network and service management has been proposed and the planning for writing and publishing is progressing.

The last EMANICS year was characterized by high numbers of EMANICS workshops and events as well as a lot of scientific visits in combination with a decreasing number of work package meetings. This shows the close collaboration of EMANICS partners working focused on one research topic in contrast to discussions on a higher level in a bigger group previously. In addition, groups of two or more partners have found joint research topics and collaborate in organizing events like, e.g., workshops open to the European or worldwide community.

2 Introduction

Besides funding mobility and PhD integration in work package 1, five activities have been carried out in the tasks *research observatory*, *common course program*, and *integration/impact/visibility measurement* in the last period of EMANICS.

The project **NSM publications in DBLP** (Partners: UT, INRIA) dealt with increasing the visibility of the management community and observing research in this area. In 2008 UT and INRIA started an activity on monitoring and improving the indexing and visibility of the community's publications. The initial objectives have been to ensure that all publications in conferences within the scope of EMANICS (IFIP/IEEE IM, IEEE/IFIP NOMS, MANWEEK) are accurate and visible through the widely accepted and used DBLP system. Information about many important venues had already been updated before but the activity continued in 2009 with proceedings that had not been available so far (e.g. earlier editions of NOMS) and additional events that are important to the community.

The project **EMIN - EMANICS Integration Tool Maintenance and Data Updates** carried out by UniBwM focused on one main objective of the EMANICS Network of Excellence: to improve cooperation and integration of European research institutions in the field of network and service management. To measure the integration of the EMANICS partners a tool called EMIN was developed. UniBwM maintained the EMIN integration tool and hosted it. Furthermore, new information that became available for 2008 and 2009 to show EMANICS integration was integrated.

The project **WwRM++ - Worldwide Research Map** was also carried out by UniBwM. A map of research and teaching activities of EMANICS partners had already been developed in the first phase of the project and was extended and updated in phase 2. Information has been gathered from different internal and external sources. In phase 3 the maintenance of the system as well as the input of new information was investigated. Published joint papers are a metric for collaboration in research, to reflect this we included data from publication databases. E.g., currently, DBLP data delivers basic information about publications but not keywords and paper topics. An extraction of keywords from the papers allows us to combine them with the developed taxonomy, and define topics of interest for researchers and thus foster their collaboration. Currently we have information available from DBLP science database and JEMS conference system. The WwRM was re-designed as a framework to allow for easy integration of new sources like CiteSeer, IEEEExplore, and ACM and combine the data with the present data. Besides that, a group selection tool was implemented to provide better support when users want to get information about a group of researchers or institutes. As the SONATA questionnaire (reported in D1.5) has shown, social network platforms (SNP) are well used by researchers. We extended the research map with SNP plugins for giving the user the opportunity to contact a found person and to get more social information about the researcher. The service is hosted and maintained by UniBwM and is available to other as a web application.

The project **Common Course Program - Part III (CCP3)** (Partners: UCL, UniZH, JUB, KTH, INRIA, UniBwM) continued the respective efforts from the previous two EMANICS phases. During phase II, a number of EMANICS partners worked out the outline, modules, and module content for a common course curriculum for a Master's program in network and service management and also considered a common PhD level curriculum. While an

MSc course in network and service management is a relatively rare offering, many Universities tend to offer Master level programs in telecommunications, data communications and distributed systems. Some of these programs offer modules in network and service management but there is little consensus regarding what such a module should include.

In Phase III, the content of a network and service management module was investigated by considering relevant courses offered by EMANICS partners (and also elsewhere) and the syllabus of a representative module that will promote the discipline was designed. Existing books from which material could be drawn were identified but, more important, the outline of an up-to-date representative support book for this module was produced. This project generated a network and service management module outline which can be part of communications-oriented Master programmes, discussing relevant options and producing a quasi-optimal general purpose outline to be documented in this report.

The project **PAOTS - A Practical Approach to the Operation of Telecommunication Services driven by the TMF e-TOM Framework** was carried out by UPC. It intended to create a course module aimed at the following objectives in respect to the students attending the course:

- Know the challenges a service provider or network operator have to face in order to provide services to their customers
- Understand the role of e-TOM in the context of the NGOSS framework and the benefits brought by its potential use by service providers
- Know how to express the needs of service providers and network operators in terms of e-TOM artefacts

The results of the proposal are documented in this report in Section 6:

1. Definition of scenarios
2. Development of an e-TOM browsing tool
3. Application of the browsing tool to one of the scenarios as defined in 1
4. Edition of supporting documentation

3 Development of research activities

Published joint papers are a metric for collaboration in research, to reflect this we included data from publication databases. E.g., currently, DBLP data delivers basic information about publications like author, title, conference, etc.

Currently we have information available from DBLP science database and JEMS conference system and have combined the data with the present data as presented in subsection 3.3. In subsection 3.2 we give a brief overview about the scientific visits and organized workshops of EMANICS partners for the years 2006-2009.

3.1 Data Sources

Our main source is the DBLP scientific database, which supports us with information concerning scientific publications. DBLP science database is known as one of the most popular bibliographic data bases for the field of computer science. It was started in 1993 as a small personal experiment. In the first years the collection was focused on the computer science subfields “Data Base systems” and “Logic Programming” (DBLP) - later this acronym become meaningless because the coverage was expanded to many other areas. The database provides only very basic bibliographic information. The main focus is authority control for author names, i.e. it is tried to identity the persons and to deal with homonyms and synonyms.

Also, the JEMS Journal and Event Management System hosted and maintained by the Computer Networks Group of the Federal University of Grande do Sul is used. As all relevant computer and service management related conference paper submissions, like IM, etc., are hosted by JEMS, so JEMS gives us additional information we can use. We combine these information with the one of the DBLP database, which gives a good overview about scientific work in the field of network management and related aspects.

3.2 Impact

Especially for a NoE scientific visits of EMANICS members are important for getting a community started. In the first years several work package meetings were necessary, but also direct visits of members of one affiliation with other EMANICS work package partners were done. In the last year (2009) no work package meetings were planed, so a higher number of sponsored scientific visits were needed and done by EMANICS members.

The number of scientific visits are the following:

2006 2

2007 5

2008 3

2009 12

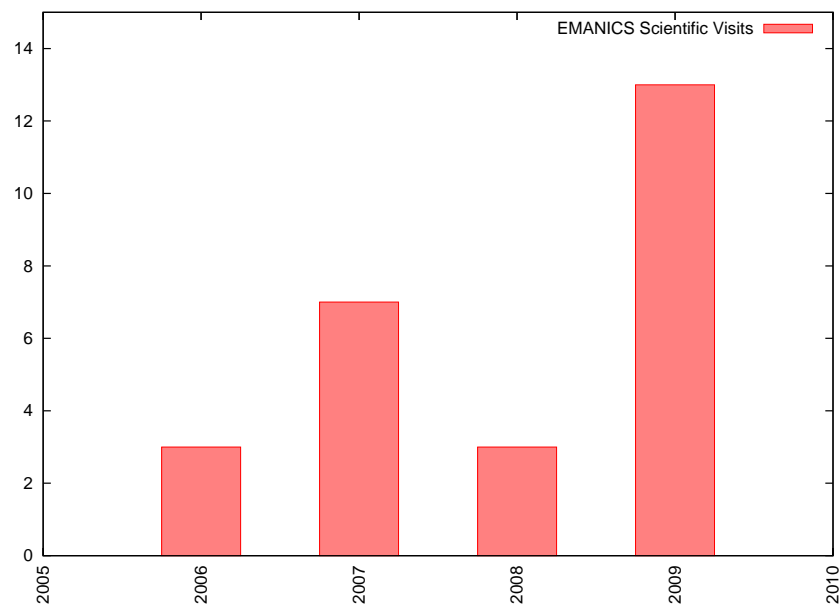


Figure 1: Scientific Visits of EMANICS Members

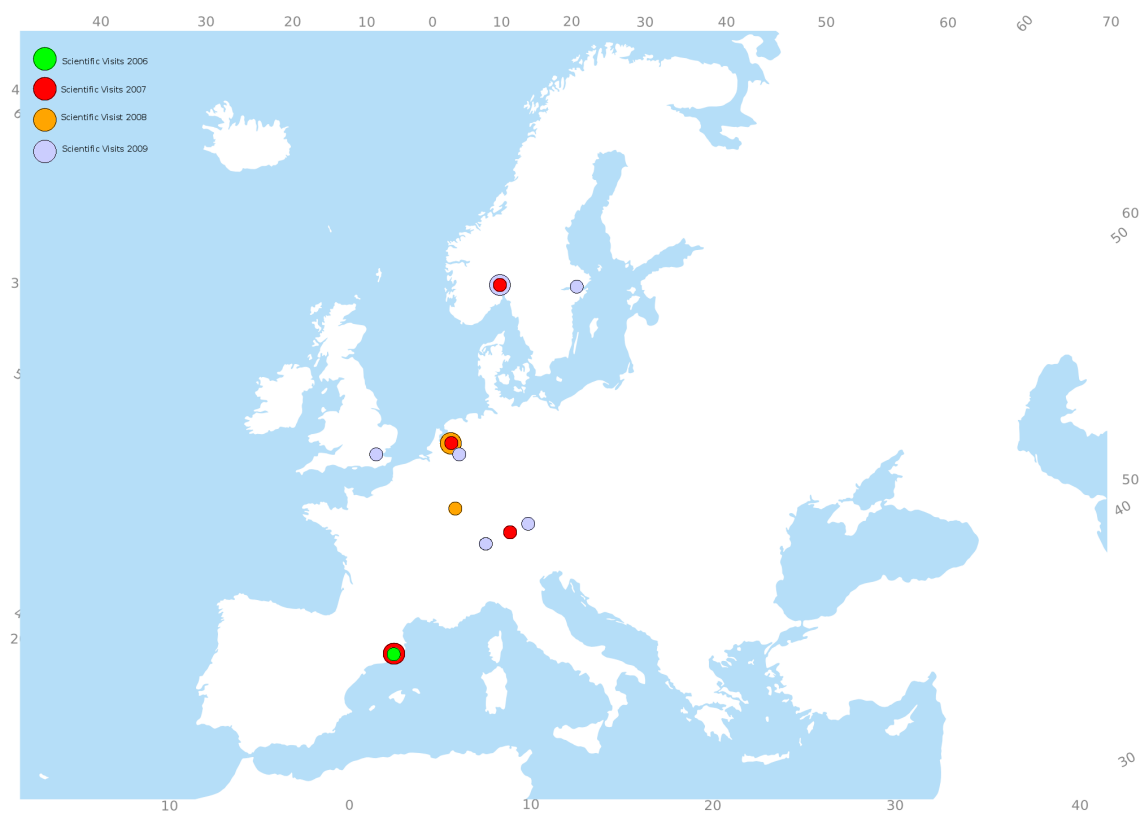


Figure 2: Scientific Visits of EMANICS Members

Figure 1 and 2 visualize the scientific visits done by EMANICS partners.

The organization of scientific workshops are a good opportunity to present the EMANICS NoE project to the scientific world. In the years 2005 – 2009 about 18 workshops were organized by EMANICS partners. Especially in the last years the number of workshops increases. Figure 3 shows the number of workshops over the years.

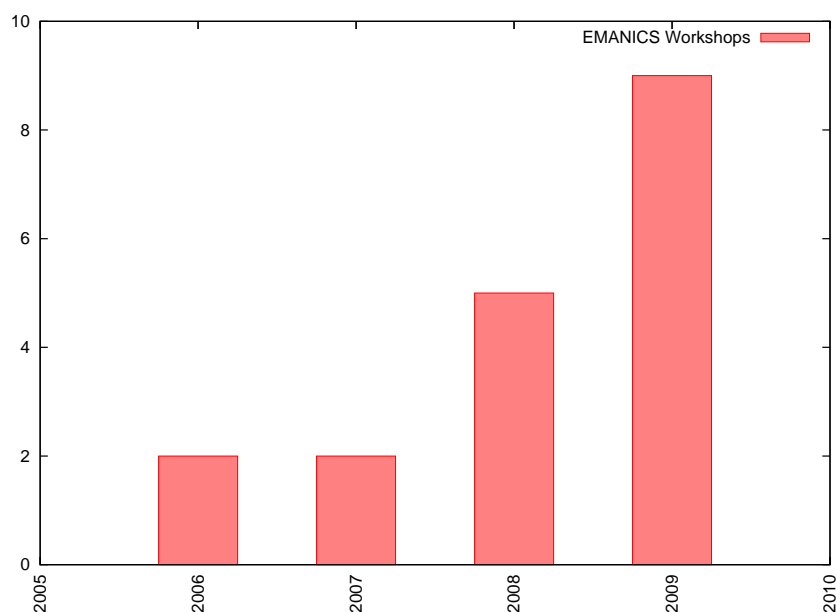


Figure 3: Workshops organized by EMANICS Members

The distribution of workshops over the European landscape is shown in Figure 4.

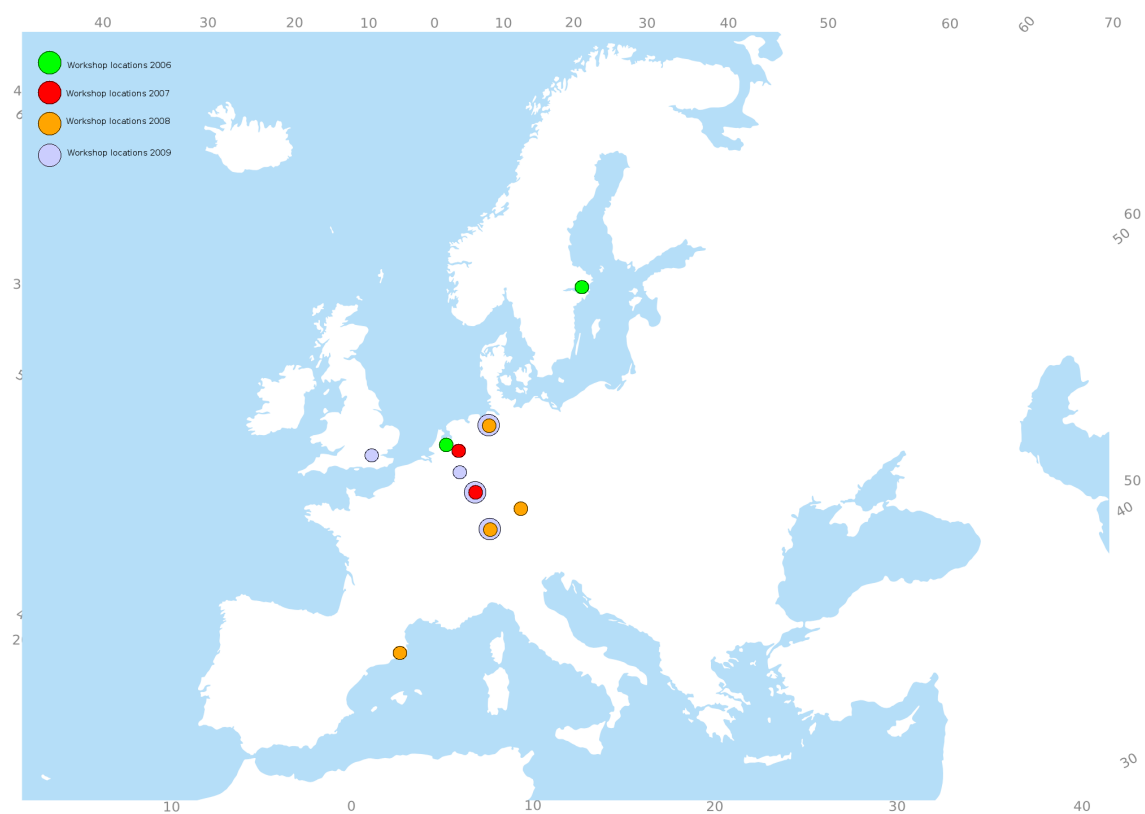


Figure 4: Workshops organized by EMANICS Members

3.3 Joint Publications

The DBLP service provides bibliographic information on major computer science journals and proceedings. So far, DBLP lists more than 1.3 million publications. The supported XML data-exchange allows us to use the DBLP data for our analysis. All following results are based on the DBLP database of Dec, 2009. Attention should be paid to the fact that the DBLP database may not be complete, especially for the year 2009.

Figure 5 shows the progress of publications for the time period of 2005 – 2009. These publications have at least one author being member of the EMANICS NoE. The publication rate of the publications is relatively stable at about 30 to 40 publications per year.

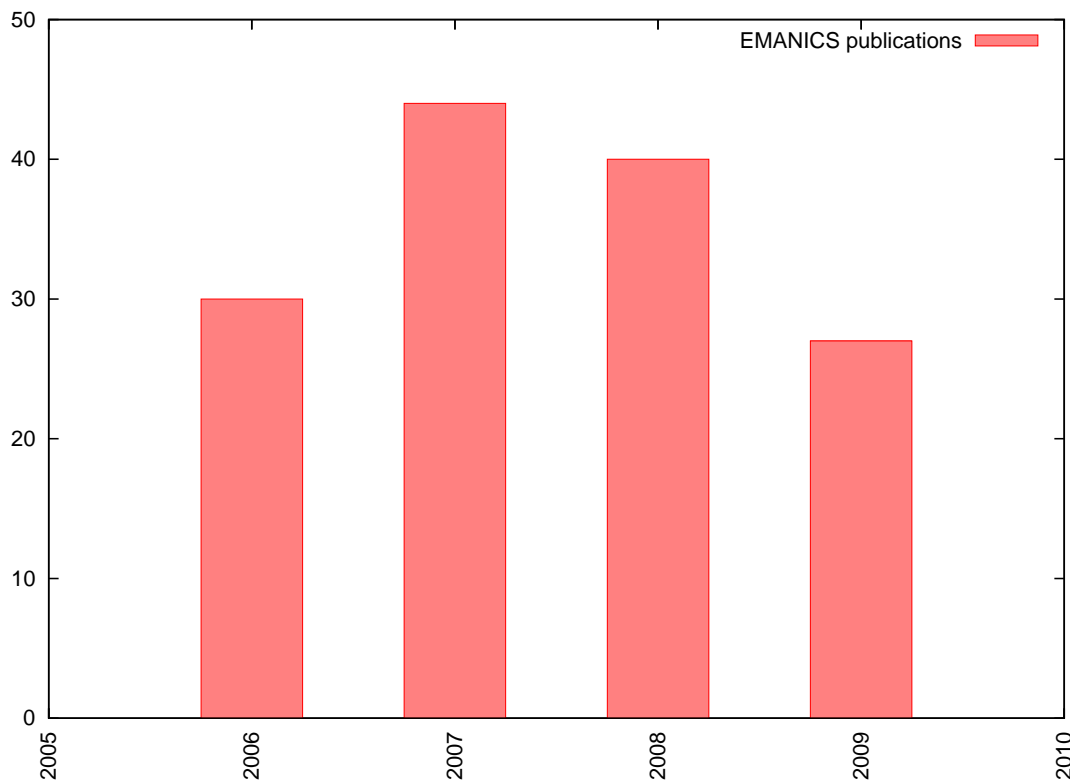


Figure 5: Number of Publications by at least one EMANICS Member involved

Joint publications are those publications, where at least two different EMANICS partners were involved. Based on the information published in DBLP database we have 4 joint publications each year (2006 – 2008). For the year 2009 no joint publications could be identified so far. This can be explained by the fact, that the DBLP database is not on status quo. The DBLP administration always needs some time for updating.

- 2006 – Marinos Charalambides, Paris Flegkas, George Pavlou, Javier Rubio-Loyola, Arosha K. Bandara, Emil C. Lupu, Alessandra Russo, Morris Sloman, Naranker Dulay: Dynamic Policy Analysis and Conflict Resolution for DiffServ Quality of Service Management. NOMS 2006: 294-304
- Gabi Dreo Rodosek, Heinz-Gerd Hegering, Burkhard Stiller: Dynamic Virtual Organizations as Enablers for Managed Invisible Grids. NOMS 2006

- Javier Rubio-Loyola, Joan Serrat, Marinos Charalambides, Paris Flegkas, George Pavlou: GOREMOCH: A Distributed Goal-oriented Policy Refinement Environment. NOMS 2006
- Javier Rubio-Loyola, Joan Serrat, Marinos Charalambides, Paris Flegkas, George Pavlou: A Functional Solution for Goal-Oriented Policy Refinement. POLICY 2006: 133-144
- 2007
 - Matthias Göhner, Martin Waldburger, Fabian Gubler, Gabi Dreo Rodosek, Burkhard Stiller: An Accounting Model for Dynamic Virtual Organizations. CCGRID 2007: 241-248
 - Remi Badonnel, Mark Burgess: Fault Detection in Autonomic Networks Using the Concept of Promised Cooperation. DSOM 2007: 62-73
 - Mark Burgess, Matthew Disney, Rolf Stadler: Network Patterns in Cfengine and Scalable Data Aggregation. LISA 2007: 275-289
 - Aiko Pras, Jürgen Schönwälder, Burkhard Stiller: Peer-to-Peer Technologies in Network and Service Management. Journal on Network and Service Management, 15 (3). pp. 285-288. ISSN 1064-7570
- 2008
 - Remi Badonnel, Mark Burgess: Service Load Balancing with Autonomic Servers: Reversing the Decision Making Process. AIMS 2008: 92-104
 - Feng Liu, Antonis M. Hadjiantonis, Ha Manh Tran, Mina Amin: An Architecture for Supporting Network Fault Recovery Management. AIMS 2008:105-119
 - Remi Badonnel, Mark Burgess: Dynamic pull-based load balancing for autonomic servers. NOMS 2008: 751-754
 - Heikki Hämmäinen, Hong Chen, Aiko Pras, George B. Huitema, Martin Waldburger, David Hausheer, Panayotis Antoniadis, Peter Reichl, Jerzy Kubasik, Burkhard Stiller: Dagstuhl Summary – Perspectives Workshop: Telecommunication Economics

3.4 Joint PhD Committees

Work package 1 has supported joint Ph.D. committees during the lifetime of EMANICS. Altogether, thirteen theses were supervised by researchers from at least two different institutions:

Date	Author	Committee Members	Title
01-12-2006	Constantin Adam	Rolf Stadler (KTH), Burkhard Stiller (UZH)	A middleware for self-managing large-scale systems
19-06-2007	Kyrre Begnum	Mark Burgess (HIO), Juergen Schoenwaelder (IUB), Rolf Stadler (KTH)	Three disciplines in system administration

29-06-2007	Javier Rubio	Joan Serrat (UPC), Rolf Stadler (KTH)	A methodological approach to policy refinement in policy-based management systems
19-07-2007	Andreas Hane- mann	Heinz-Gerd Hegering (LMU), Gabi Dreo Rodosek (UniBwM)	Automated IT service fault diagnosis based on event correlation techniques
26-07-2007	Martin Sailer	Heinz-Gerd Hegering (LMU), Gabi Dreo Rodosek (UniBwM)	Conception of a service MIB - Analysis and specification of service-oriented management information
11-12-2007	Abdelkader Lah- madi	Olivier Festor (INRIA), Aiko Pras (UT)	Management Architectures Benchmarking
29-02-2008	Peter Racz	Burkhard Stiller (UZH), Aiko Pras (UT)	A Generic Accounting Configuration Architecture for Multi-Service Mobile Networks
30-05-2008	Edgar Magana	Joan Serrat (UPC), David Hausheer (UZH), Laurent Lefevre (INRIA)	A Distributed and Heuristic Policy-based Management Architecture for Large-Scale Grids
16-07-2008	David Schmitz	Heinz-Gerd Hegering (LMU), Gabi Dreo Rodosek (UniBwM)	Automated Service-Oriented Impact Analysis and Recovery Alternative Selection
22-10-2008	Martin Serrano	Joan Serrat (UPC), Gabi Dreo Rodosek (UniBwM)	Management and Context Integration based on Ontologies for Pervasive Service Operations in Autonomic Communications Systems
21-11-2008	Alberto Gonzalez Prieto	Rolf Stadler (KTH), George Pavlou (UCL), Olivier Festor (INRIA)	Adaptive Real-time Monitoring of Large-scale Networked Systems
03-03-2009	Matthias Goehner	Gabi Dreo Rodosek (UniBwM), Heinz-Gerd Hegering (LMU)	A Service-oriented Accounting System for Dynamic Virtual Organizations
07-12-2009	Radu State	Olivier Festor (INRIA), Aiko Pras (UT)	tbd

3.5 NSM publications in DBLP

Another activity centered on research observatory and visibility of network and service management (NSM) topics in research worldwide has been the monitoring an improve-

ment of NSM publication data in the DBLP. In the second EMANICS phase, data has been updated to include older proceedings in this area and many entries have also been corrected. The activity has continued in 2009 but as many proceedings had been entered already, the focus was shifted to establish procedures to automatically include relevant data in the future.

The alignment of processes for easier inclusion of relevant IEEE data on publications has been more cumbersome than expected. Support from COMSOC is crucial and this process - while some positive feedback already has been given - is still ongoing. In addition, DSOM proceeding updates will be submitted soon (which then completes the inclusion of DSOM proceedings until back to the year 1999).

4 EMANICS Integration Tool Maintenance and Data Updates

A map of research and teaching activities of EMANICS partners has already been developed in the first phase of the project and was extended and updated in phase 2. Information has been gathered from different internal and external sources. In phase 3 the maintenance of the system as well as the input of new information was investigated.

Data sources have been updated as new information became available, e.g. an import of the DBLP database has been conducted and information from EMANICS that cannot be added automatically has been added manually.

We have developed an automatic data update tool in order to adapt new data sources with a reasonable effort.

DBLP, like other sources also, often includes links to a pdf version of the paper. We can download the most relevant and available papers and can do a keyword extraction based on a frequency analysis (not relevant words are excluded). This keyword list is combined with the keywords that are already available for some publications and are used in the WwRM application.

For the extraction of keywords some steps have to be done. First of all, we need the web-link to download the publication for a later analysis. Therefore we use information given by the DBLP database like the DOI number or a given link in the DBLP database were available. Concerning the DOI number we can use search engines like CiteSeer or the IEEEExplorer to find the relevant document. We have written a little BASH script which extensively uses the tool *wget* for downloading the pdf file based on the information of the DBLP database. The next step is to migrate the pdf file to basic text-file. Therefore, we use the *pdf-utils* package (freely available for the most LINUX distributions). This tool first migrates the pdf file to a postscript one and then extracts the text to a basic text file. This basic text file is used in the third step for a frequency analysis. The analysis tries to find the most used words in the text file first by simply counting all found words in the text. By using a blacklist all not relevant words, like and, to, etc., are identified and the word count is reduced towards only having relevant keywords afterwards. As result the 100 most used words are stored in a database with cross-reference to the DBLP key. With the help of the keyword extraction the EMIN and WwRM application are now based on more relevant information. The found publication keywords are next to the title of the publications the reference concerning all search requests. Users can now find more precise information about network management related work. Also, it is possible to use this script for all other publications in the DBLP database. So not only network management related publication can be analysis. Extraction of relevant keywords may help other to build EMIN and WwRM-like tools for their interests.

As the SONATA questionnaire (reported in D1.5) has shown, social network platforms (SNP) are well used by researchers. We have extend our research map with a SNP plugin from *LinkedIn* for giving the user the opportunity to contact a found person and to get more social information about the researcher and its affiliation. Figure 6 shows exemplary information for the university of Oslo.

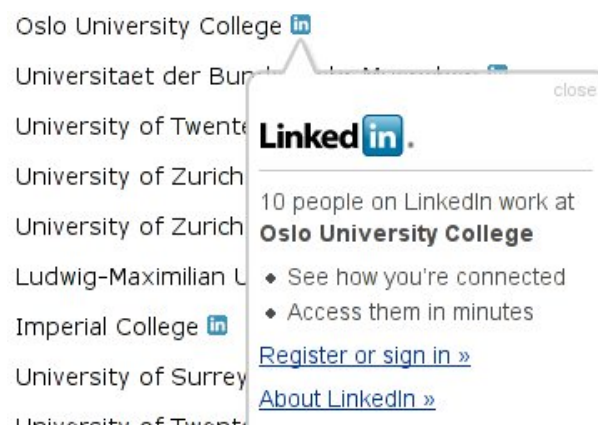


Figure 6: LinkedIn social network addon integration

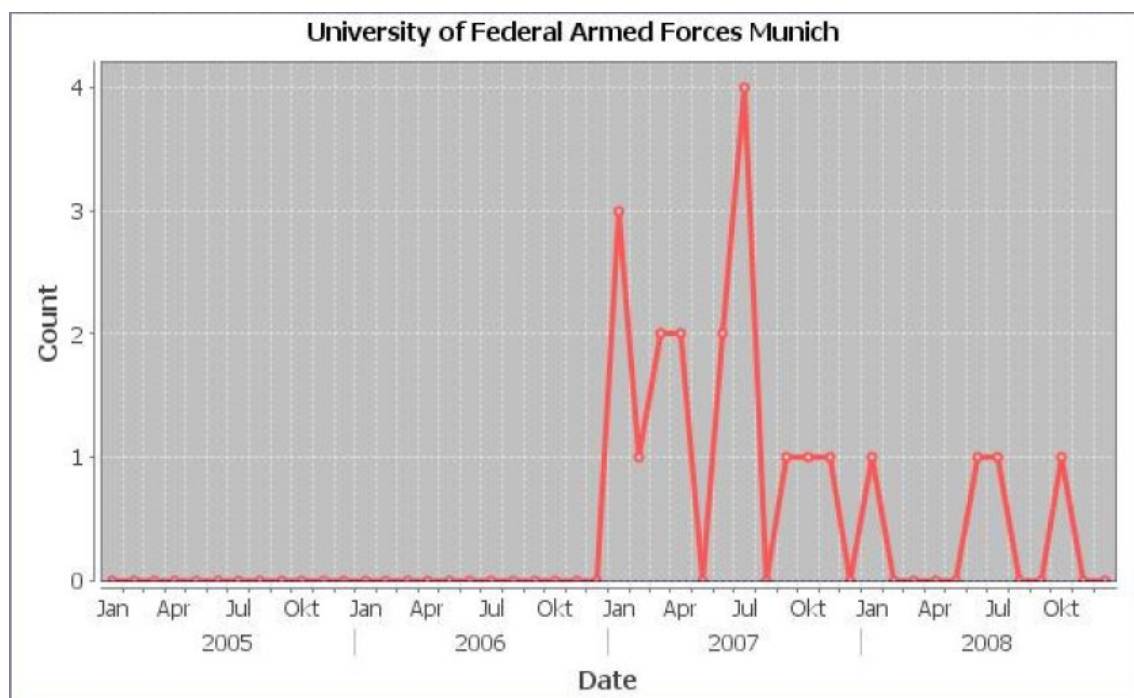


Figure 7: Activities Graph

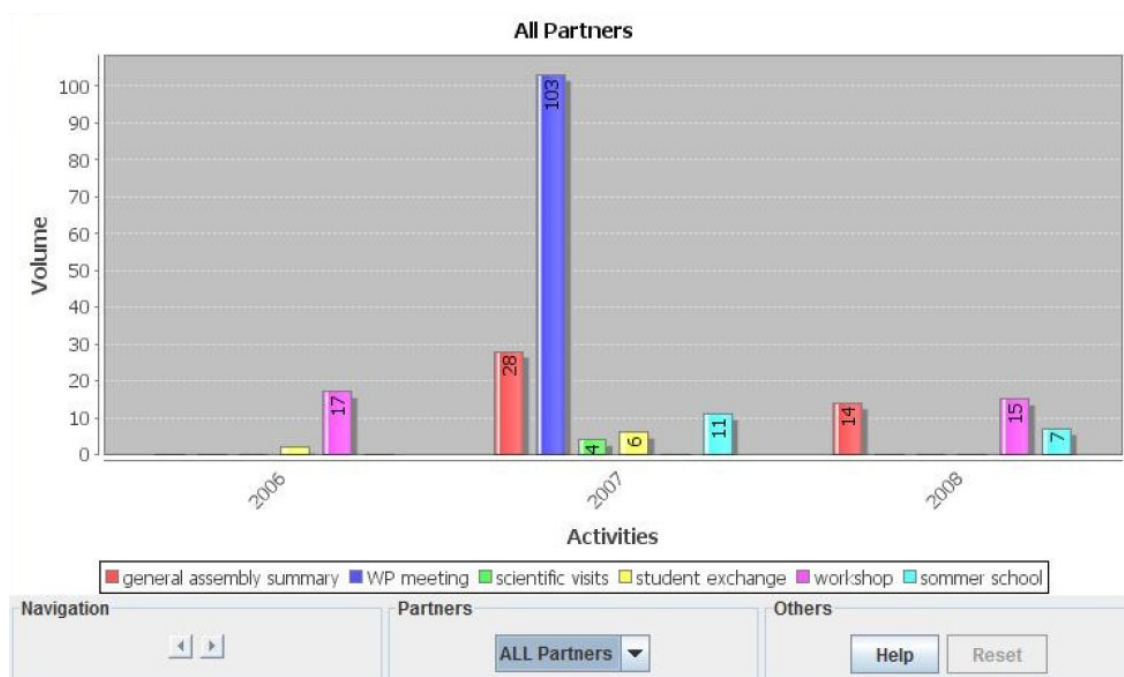


Figure 8: Activities Chartbar

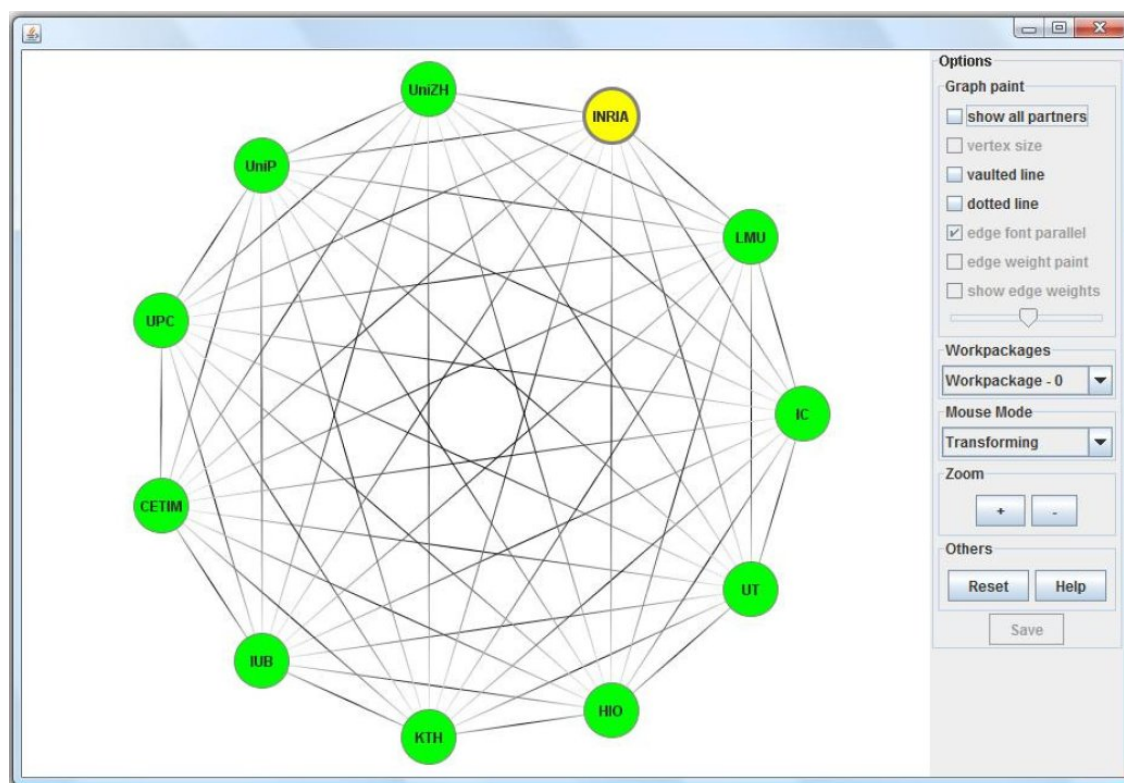


Figure 9: EMANICS Membership visualized



Information Society Technologies

EMANICS

Emanics Research Map

» Home
» Graphs / Charts / Maps
» EMANICS Activities
» EMANICS Conferences
» EMANICS Workpackages
» EMANICS Research Map
» EMANICS Publications

EMANICS Conferences Listing

The observation of conferences, topics and trends in network and service management world-wide is essential to the Network of Excellence. This conferences map combines data from two different kind of sources. On the one hand, it shows the topics of all EMANICS conferences based on co-authored publications. On the other hand, research topics from conferences and workshops are used where an EMANICS partner took an active role from general chair to member of the technical program committee.

management search for topics

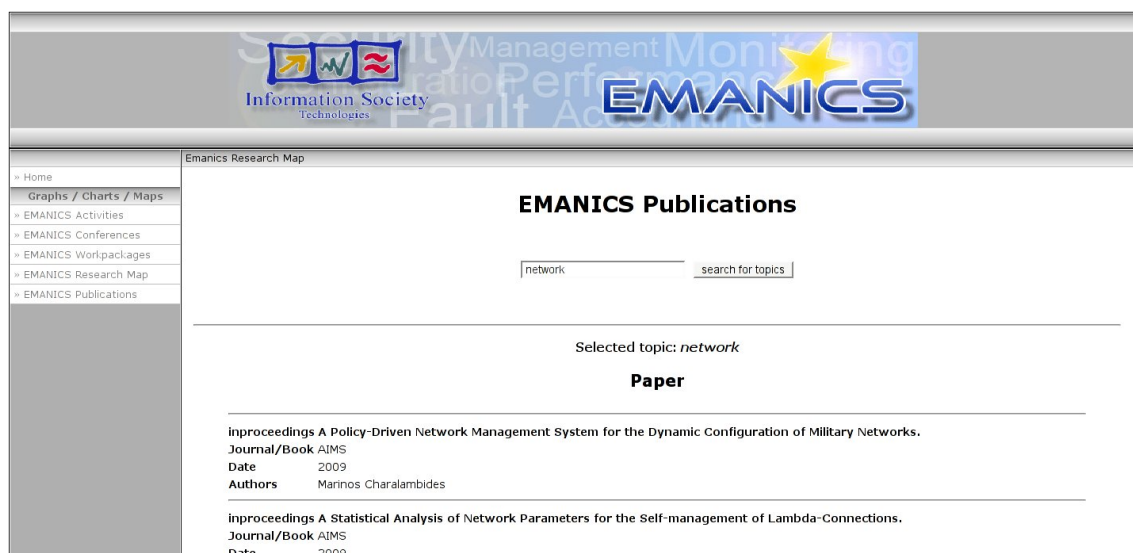
Researcher interested in topic: *management*

Conferences

conference NOMS 2010 Application Sessions (Format: annotated slides) (NOMS 2010 Application Sessions)

Member Prof. Burkhard Stiller (University of Zurich and ETH Zurich)
Role member
Time 2010-04-19 - 2010-04-23
Topics of interest
Management of emerging Networks and Services
Virtualization, Grids, Clouds and P2P Overlays
Accounting Management and Service Level Reporting
OSS/BSS Development

Figure 10: Tool listing participated Conferences



Information Society Technologies

EMANICS

Emanics Research Map

» Home
» Graphs / Charts / Maps
» EMANICS Activities
» EMANICS Conferences
» EMANICS Workpackages
» EMANICS Research Map
» EMANICS Publications

EMANICS Publications

network search for topics

Selected topic: *network*

Paper

inproceedings A Policy-Driven Network Management System for the Dynamic Configuration of Military Networks.
Journal/Book AIMS
Date 2009
Authors Marinos Charalambides

inproceedings A Statistical Analysis of Network Parameters for the Self-management of Lambda-Connections.
Journal/Book AIMS
Date 2009

Figure 11: Tool listing EMANICS publications

The services are hosted and maintained by UniBwM and they are available as a web application at:

<http://inf3-www.informatik.unibw-muenchen.de/emanics/project/HTML>.

5 Common Course Program

5.1 Introduction

After developing a syllabus for a European Master's degree program in network management in the previous phase it was agreed that besides such a specialized program, there is high need for a course module on network and service management as part of a Master level program in telecommunications, data communications, distributed systems and the like. Thus, the last phase of EMANICS wrt. to a common course program concentrated on this topic. To further increase practical usability of the results of our results, it was agreed upon formulating such a syllabus in the form of a text book outline and to jointly work on creating this text book.

Within the course of this activity, existing relevant text books were evaluated if there is need for another text book at all. The findings can be summarized as follows:

- The Sloman book (1994) is a bit dated and not covering newer topics.
- The Hegering book (1999) is not specifically written as a text book.
- The Lewis book (2001) mainly discusses cases studies and how the Spectrum management tool can be used.
- The Bergstra / Burgess book (2007) is designed as a handbook (approximately 1000 pages) and not suited as a course book.
- The Limoncelli / Hogan Chalup book (2007) is written from a practical system administration perspective and does not qualify as university textbook.
- The Clemm book (2007) provides a somewhat Cisco centric view on network management and it is not written as a university textbook .
- The Martin-Flatin book (2003) is specific on using web-based technologies for network and service management.
- The books Feit (1993), Stallings (1999), Stallings / McGinnis (1996), Saperia (2002), Zeltserman (1999), Rose / McCloghrie (1995), etc. are all specific to a single management technology.

5.2 Proposed outline for the course book

Based on previous examinations of courses on network and service management offered in various institutions, we propose the following outline for the text book (the order chapter order is arbitrary):

Part 1: Fundamentals (Aiko Pras)

1. Introduction

- (a) What is 'Network Management'?
 - (b) Why is Network Management needed?
 - (c) How is Management performed?
 - explicit vs. implicit management
 - centralized vs. distributed management
 - evolution of management technologies
2. Concepts and Terminology
- (a) Network Management Functions
 - (b) Managers and Agents
 - (c) Distributed Management
 - (d) Information Models and Data Models
 - (e) Policies
3. Network Management Interactions
- (a) Variable-oriented Approach
 - (b) Command-oriented Approach
 - (c) Object-oriented Approach
 - (d) Document-oriented Approach
4. Hierarchies of Management Information
- (a) Element Management
 - (b) Network Management
 - (c) Service Management
5. Management Architectures
- (a) OSI Management
 - (b) TMN Management
 - (c) Internet Management
6. Security Aspects and Principles
- (a) Authentication
 - (b) Privacy
 - (c) Authorization
 - (d) Accounting

Part 2: Network Management Protocols (Juergen Schoenwaelder)

1. Monitoring: SNMP

- (a) SNMP Framework
 - history of SNMP
 - original design goals
- (b) Structure of Management Information
- (c) Standard Management Information Bases
 - notations (uml, case, tree diagrams)
 - logical network interfaces
 - physical components
 - host resources and printers
 - IEEE 802 networks
 - IP / UDP / TCP
- (d) SNMP Protocol
 - architecture
 - protocol operations
 - security and authorization
- (e) Advanced Features
 - proxies
 - extensible agents
 - remote network monitoring

2. Configuration: NETCONF

- (a) NETCONF Framework
 - history of NETCONF
 - original design goals
- (b) Information Modeling (YANG)
- (c) NETCONF Protocol
 - architecture
 - data stores
 - protocol operations
 - transports
 - security and authorization
- (d) Advanced Features
 - DSDL / RNG / XSD translations
 - SMI translations

3. Logging: SYSLOG

- (a) SYSLOG Framework
- (b) Information Modeling

- (c) SYSLOG Protocol
- 4. Measuring: IPFIX (NetFlow)
 - (a) IPFIX Framework
 - (b) Information Modeling
 - (c) IPFIX / NetConf Protocol
- 5. Authentication, Authorization, Accounting: RADIUS / DIAMETER
 - (a) AAA Framework
 - (b) Information Modeling
 - (c) RADIUS Protocol
 - (d) DIAMETER Protocol

Part 3: Traffic Engineering (George Pavlou)

[TBD]

Part 4: Distributed Management (Rolf Stadler)

[TBD]

Part 5: Event Correlation and Root Cause Analysis (TBD)

[TBD]

Part 6: IT Service Management (Gabi Dreo-Rodosek)

[TBD]

Part 7: Economic Aspects of Management (Burkhard Stiller)

- 1. Introduction to Economic Management of IP Services
 - (a) Motivation and View Points
 - (b) Basic Terms and Definitions
- 2. Economic Traffic Management
 - (a) Challenges
 - (b) Economic Principles and Pricing
 - (c) Quality of Service and Traffic Classes
 - (d) Time Scales
 - (e) Economic Management of Overlay Traffic
- 3. Pricing
 - (a) Introduction
 - (b) Usage-based Pricing Scheme

- (c) Flat Fees
 - (d) Cumulus Pricing Scheme
 - (e) Pricing Expected Capacity
 - (f) Priority Pricing
 - (g) Responsive Pricing and Auction Pricing
4. Service Level Agreement Compliance Auditing
 - (a) Definition of Terms
 - (b) Sample Scenarios
 - (c) Auditing Systems for Different Types of SLAs
 - (d) Auditing of Multi-Domain IP Carrying SLAs
 5. Usage and Performance Management
 - (a) Introduction
 - (b) Metrics
 - (c) Time and Synchronization
 - (d) Protocols
 - (e) Sampling
 - (f) ITU-T E-Model
 - (g) Perceptual Evaluation of Speech Quality (PESQ)
 6. Pricing and Accounting in Peer-to-Peer Networks
 - (a) Peer-to-Peer Market Management
 - (b) Decentralized Accounting
 7. Accounting in Grid Environments
 - (a) Introduction
 - (b) Service Model for Virtual Organizations
 - (c) Taxonomy of Grid Resources
 - (d) Accounting of Complex Grid Services

Part 8: Policies, Contexts, Ontologies (Joan Serrat)

1. Policy-based Management Paradigm
2. Policy Management Models
 - (a) CIM and PCIM
 - (b) Policy modelling in TMF SID
 - (c) DEN-ng Policy Model

- (d) Context for Policy Decision
- (e) Ontology Engineering for Context and Policy Modeling
- (f) Policy Continuum
- 3. Policy Languages
 - (a) XML for Policy Descriptions
 - (b) Ponder
 - (c) Other Policy Languages
- 4. Policy Refinement
 - (a) Goal-oriented Policy Refinement
 - (b) Other Approaches
- 5. Policy Conflict Detection and Resolution
 - (a) Conflict Typology and Detection Mechanisms
 - (b) Conflict Resolution based on FSTs
- 6. Example Scenarios

Part 9: Self-Management (TBD)

[TBD]

Part 10: Network Measurement (TBD)

[TBD]

Part 11: Security Management (TBD)

- 1. Identity Management
- 2. Authentication, Authorization, Accounting
- 3. Reputation Systems

6 A Practical Approach to the Operation of Telecommunication Services driven by the TMF e-TOM Framework (PAOTS)

6.1 Introduction

Service providers in many sectors experience great competition due to growing customer expectations, full market share, and increasing price pressures. As a result, they feel pressure to clearly define and understand the business processes they use to deliver convergent services in the competitive environment. The first step to understand these processes is to work with a well established model framework.

In order to provide a common process language that is open and flexible enough for all to use, the TM Forum Business Process Framework (eTOM) [1] provides a reference framework for categorizing all business activities at all levels of enterprises. The focus of the Business Process Framework are the business process, the linkage among processes, the identification of interfaces and the use of customer, service, resource, supplier partner and other information by multiple processes.

The analysis of all phases of business processes makes the Business Process Framework a critical tool for improving ongoing development. For suppliers and partners trying to identify category process used in business to business attraction, the Business Process Framework serves to assist relationship by identifying where the interdependence exists; the most efficiently deliver services to customers. For planer, manager and strategists, the Business Process Framework helps in the assessment of process structure, process component, process interactivity and the business roles in responsibility to which they rely. This assessment ability gives them advises for setting accurate requirement for solutions, technical architectures, technology choices and implementation tasks.

The PAOTS project was intended to set the grounds for a course module as part of task T1.3 in EMANICS aimed at the following objectives in respect to the students attending the course:

- Know the challenges a service provider or network operator have to face in order to provide services to their customers
- Understand the role of e-TOM in the context of the NGOSS framework and the benefits brought by its potential use by service providers
- Know how to express the needs of service providers and network operators in terms of e-TOM artefacts

To accomplish these objectives we identified a scenario and two use cases within it. A proof of our understanding of the framework would be indeed to be able to express the service provider needs in terms of the e-TOM constructs and elements. Also, it would be necessary to use modeling tools to help in the description of the business processes. Initially we had believed to build one of such modeling tools, but due to its high complexity and to the facilities offered by the industry to universities we decided to adopt an existing

tool, namely ArcheTom [2]. In the following subsections we present the scenario and use cases and the results obtained, in terms of the specification within the framework.

6.2 Scenario and use cases

Assume a new content provider company wishing to align its business processes with eTOM. The content provider company is MEDIA, an SME that owns different types of multimedia content. This content includes video and audio which is enabled to offer to its customers. The services are orientated to people living in a given geographical area which are interested in the content. As for the network, they are also equipped with the appropriate access device of their own.

The offer of MEDIA is available through a catalog visible as an Internet portal. Furthermore, the content is stored in different types of media. Selective subscription has the access to different types of content as well as different types of QoS. The QoS standard was divided into gold, silver and bronze. It is selected by the customer at subscription time. As for the billing scheme, it charges not only the fixed rate for service subscription type, but also *pay per view*.

Instead of buying their own servers and carrying out the corresponding operation, MEDIA has signed an agreement with CLOUD, another company that materializes the concept of ?cloud computing?. In this particular case, CLOUD is offering to host the content of MEDIA in appropriate servers, making them accessible through the Internet with a given end-to-end latency. Acting as a provider, CLOUD is supporting an overlay network. When a request is received, it is redirected to the most appropriate server which stores the content ordered by the subscriber. In the mean time, CLOUD has access to the Internet through an Internet service provider, as shown as the Figure 12.

Moreover, in order to make an easy access to its potential customers, MEDIA has decided to deploy its own access network to the Internet. This network will consist of a mix of WiMAX and WiFi technology conveniently deployed in the area of coverage. Interconnection of the wireless network and the fixed network is through an Internet service provider mentioned above.

MEDIA will install the OSS in a central location which supports the business process of the company. This OSS includes the business processes that are the subject of this project.

6.2.1 Use case 1. Service subscription

One of the most basic end-to-end processes a service provider must support is to ensure the appropriate response to a potential customer service request. A subscription process defines who has access to selected information. Whether we are developing a newsletter, delivering regular e-mail-based or telephone communications to internal or external subscribers, we will need a process to ensure that the right people are accessing only the information intended for them. Let's imagine an individual who never had any relationship with MEDIA. This means that the company has no records about the identity or the profile of that person. Our user is roughly aware of the MEDIA services through advertisements

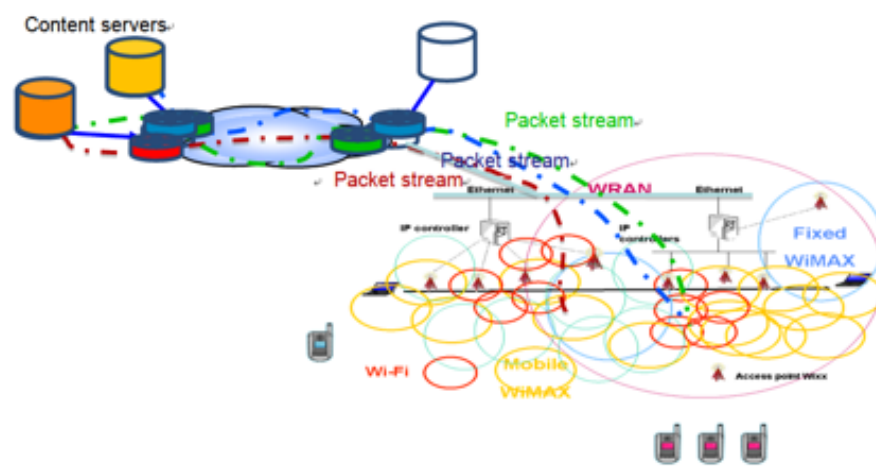


Figure 12: Network infrastructure supporting the scenario

he got through his mail. He knows the URL and contact of the company and he expects that through a relatively simple interaction process he will end with the payment of his subscription and he will be ready to view his first movie.

Summarizing, the use case is triggered by an unknown user and ends with a formal subscription to one particular service of the MEDIA portfolio.

6.2.2 Use case 2. Problem complain

Going back to the user mentioned in Use Case 1, now already a customer of MEDIA, assume that he has been enjoying satisfactorily of different content programs when suddenly, viewing the retransmission of a match of his football team he observes an abnormal deterioration of the quality of the image. He starts again the program, thinking that perhaps is due a transitory network problem, but arriving at the same scenes the quality worsens again. At that moment, the customer decides to contact MEDIA expecting a quick and efficient solution to this problem. The mechanism to communicate problems observed in the service is by filling a form that is provided in the web site. He fills and sends the form and waits for the answer of the company via e-mail.

Summarizing, this use case is triggered by the user at the moment of detecting a problem and will be ended by the service provider contacting the user that the problem is solved or giving him alternative options or compensations if necessary.

6.3 Solution design approach

With the background introduced before, we devote into the solution of the scenario. Our focus will be the two described uses cases. In other words, our business process deployment methodology will be driven to support the above mentioned use cases in the context of the previously defined scenario.

The design and deployment of the business processes of a company is not easy. The make it more affordable, we have established a deployment program that ranks the busi-

ness processes in three priorities. With priority number 1 we consider the processes that have to be ready at the company startup. With priority number 2 we include the processes that will be implemented in a subsequent phase. Finally, with priority number 3 we consider other processes whose implementation will be reviewed according to the business evolution. In the case of MEDIA, it is a starting company in a small scale and we only take into account the business processes needed in a time frame up to 3 or 6 months. Due to the small scale of Media, we prefer to consider other processes later, as the company gets bigger.

Firstly, we select the process according to the current situation of MEDIA, from upper level to lower levels until Level 3. In Level 1, we discard the Strategy, Infrastructure & Product (SIP) and Enterprise Management (EM) sections to cope with the specific case of MEDIA. The reasons to adopt this decision are various. The Strategy, Infrastructure & Product process area provides the focus within the enterprise for generating specific business strategy and gaining buy-in within the business. At the same time, the Enterprise Management contains elements that relate to both policy setting and support of the enterprise. They are both relatively overweighed for a small starting company as Media. Therefore, we will not pay attention in the scenario design.

As for the Level 2, we focus on the Operations (OPS) excluding Operations Support & Readiness (OSR). In fact, this later area includes those processes needed to ensure that customer operations processes can respond with what the customer requires, in a time-frame and cost the customer requires, including delighting the customer with delivery and support. In this project, support processes are not so urgent and necessary for our current small company. Then, we try to master all the functionality in the Fulfillment, Assurance and Billing (FAB) part and select the processes concerned to instantiate the description of each process according to the situation of our SME company.

On the other hand, the eTOM is a decomposition model from a notional Level 0 through to Level 3. In order to keep the eTOM to a level which is generally useful, TMF is not intended to decompose the eTOM to further levels beyond Level 3. It is asserted that the further a decomposition is taken, the more difficult it is to prove the uniqueness of lower level processes. The mechanism of decomposition can be extended as required. In this project we have decided to set the end-point at Level 4 because we have sufficient detail to use within our business in this project. Since MEDIA is a starting SME, the processes selected which are decomposed until Level 4 are adequate.

Last but not least, the eTOM framework includes a considerable amount of process flow modeling to support and apply the process decompositions. The control flow defines the logic of business processes i.e. the enterprise behavior in terms of a sequence or order in which enterprise activities must be performed to achieve business objectives. According to the sequences of the processes, we arrange the business process as a flow diagram to demonstrate the scenario use cases.

6.4 Detailed design

In eTOM framework, a top-down approach was adopted. This enabled the definition of the Business Process Framework at the Enterprise level in a series of Level 1 process

groupings. These Level 1 processes are split into Vertical and Horizontal groupings, with the dependant Level 2 processes positioned within the Vertical and the Horizontal grouping appropriate to the process concerned.

6.4.1 Process instantiation

After analysis and evaluation for the first step of scenario implementation, we chose FAB Vertical groupings crossed with 4 other Horizontal groupings as the focus in Level 1. Based on the situation of MEDIA, the instantiation with description in Level 1 is described as below:

Fulfillment:

Description: This process is responsible for providing customers with their requested products in a timely and correct manner.

It is responsible for MEDIA to provide subscribers a set of pre-established content services with different QoS performance levels (bronze, silver, and gold) which depends on their subscription in a timely and correct manner.

Assurance:

Description: This process is responsible for the execution of proactive and reactive maintenance activities to ensure that services provided to customers are continuously available and to SLA or QoS performance levels.

It is responsible for the execution of proactive and reactive maintenance activities in MEDIA with its wireless network and relevant hardware and software as well such as the wireless routers and the operating systems to ensure the content service provided to subscribers are continuously available and to QoS performance levels (bronze, silver, and gold).

Billing & Revenue Management:

Description: this process is responsible for the collection of appropriate usage records, determining charging and billing information, production of timely and accurate bills, for providing pre-bill use information and billing to customers, for processing their payments, and performing payment collections. In addition, it handles customer inquiries about bills, provides billing inquiry status and is responsible for resolving billing problems to the customer's satisfaction in a timely manner. This process grouping also supports prepayment for services.

It is responsible for MEDIA to provide timely and accurate bills, for providing pre-bill use information and billing to customer according to the QoS subscribed and in a pay per view basis, for processing their payments, and performing payment collection.

Customer Relationship Management (CRM):

Description: CRM process grouping considers the fundamental knowledge of customers needs and includes all functionalities necessary for the acquisition, enhancement and retention of a relationship with a customer.

It is responsible for the fundamental knowledge of subscribers needs and includes all functionalities necessary for the acquisition, enhancement and retention of a relationship with a subscriber.

Service Management & Operations (SM&O):

Description: This horizontal functional process grouping focuses on the knowledge of services (Access, Connectivity, Content, etc.) and includes all functionalities necessary for the management and operations of communications and information services required by or proposed to customers.

It is responsible for the knowledge of content services and includes all functionalities necessary for the management and operations of content services required by or proposed to subscriber.

Resource Management & Operations (RM&O):

Description: Maintains knowledge of resources (application, computing and network infrastructures) and is responsible for managing all these resources (e.g. networks, IT systems, servers, routers, etc.) utilized to deliver and support services required by or proposed to customers.

It is responsible for MEDIA to maintain knowledge of the wireless network infrastructures and manage all wireless routers, content and operating systems etc. utilized to deliver and support the content services required by or proposed to subscribers.

Supplier/Partner Relationship Management (S/PRM):

Description: This horizontal functional process grouping supports the core operational processes, both the customer instance processes of Fulfillment, Assurance and Billing & Revenue Management and the functional operations processes. Supplier/Partner Relationship Management (S/PRM) processes align closely with a supplier's or partner's Customer Relationship Management processes.

It is responsible to issue purchase orders and track them through to delivery, mediation of purchase orders as required conforming to external processes, handling problems, validating billing and authorizing payment, as well as quality management of CLOUD and the Internet provider. It is important to note that when MEDIA sells content to CLOUD or the internet provider, this is done through the enterprise CRM processes, which act on behalf of CLOUD or the internet provider or MEDIA in such cases. Supplier/Partner processes only cover the buying of CLOUD or the internet provider supplied products by Media [1].

6.4.2 Process priority classification

Referring to the first priority, we select the processes to ensure MEDIA to run the business smoothly in the first phase up to 3 or 6 months. Here we present part of the instantiated Level 3 processes. The complete set can be found in [3].

OPS 1.0 - Customer Relationship Management**OPS 1.2.6 - Develop Sales Proposal**

MEDIA has to develop a sales proposal to respond to the subscriber's requirements on the content provided.

OPS 1.3.2 - Track Leads

Track leads help to pinpoint the best sources, maintain lead quality, analyze marketing performance, manage future sales and manage and modify marketing plans.

OPS 1.4.1 - Determine Preorder Feasibility

Before activating the services, MEDIA needs to ensure the feasibility of providing and supporting the product ? content service to the subscriber.

OPS 1.4.2 - Authorize Credit

Due to the billing method, MEDIA needs to assess a subscriber's credit worthiness, the availability to pay online with their credit cards.

OPS 1.4.3 - Receive PO & Issue Orders

MEDIA will receive a content service order through internet and issue it to provide the service.

OPS 1.4.4 - Track & Manage Customer Order Handling

MEDIA needs to ensure subscriber provisioning activities are assigned, managed and tracked efficiently.

OPS 1.4.5 - Complete Customer Order

MEDIA needs to manage subscriber information and interactions after associated content service orders have been finalized and during the order completion phase.

OPS 1.4.6 - Issue Customer Orders

MEDIA has to issue correct and complete subscriber orders.

OPS 1.4.7 - Report Customer Order Handling

Monitoring the status of subscriber orders, it provides notifications of any changes and management reports.

OPS 1.4.8 - Close Customer Order

After subscriber provisioning activities have been completed, MEDIA need to close a subscriber order.

OPS 1.5.1 - Isolate Customer Problem

When there is problem complained by the subscriber, MEDIA need to identify the root cause of the subscriber problem.

OPS 1.5.2 - Report Customer Problem

Monitoring the status of subscriber problem reports, it provides notifications of any changes and management reports.

OPS 1.5.3 - Track & Manage Customer Problem

MEDIA needs to ensure that recovery activities are assigned, coordinated and tracked efficiently, and that escalation is invoked as required for any open subscriber problem reports in jeopardy.

OPS 1.5.4 - Close Customer Problem Report

MEDIA needs to ensure that a problem affecting the subscriber is solved.

OPS 1.5.5 - Create Customer Problem Report

MEDIA needs to create a new subscriber problem report.

OPS 1.5.6 - Correct & Recover Customer Problem

MEDIA had to restore the service to a normal operational state as efficiently as possible.

OPS 1.6.2 - Manage QoS/SLA Violation

MEDIA need to ensure that the subscriber and the relevant internal processes are informed of service quality degradations and violations and that action is undertaken to resolve the degradation or violation.

OPS 1.7.1 - Manage Contact

We need to manage all contacts/requests between potential subscribers and MEDIA.

OPS 1.7.2 - Manage Request (Including Self Service)

MEDIA needs to manage all requests (inbound and outbound) made by potential subscribers.

OPS 1.7.3 - Analyze & Report on Customer

MEDIA has to perform all necessary analysis on closed content service requests and generate related reports.

OPS 1.7.4 - Mediate & Orchestrate Customer Interactions

MEDIA needs to ensure that transaction message structure and interactions conform to agreed, externally defined standards used by MEDIA and its subscribers.

OPS 1.9.1 - Manage Customer Billing

MEDIA needs to ensure effective management of the subscriber's billing account as it relates to the content service purchased throughout the appropriate billing cycle.

OPS 1.11.5 - Report Customer Bill Inquiry

MEDIA has to report on the subscriber's bill inquiry.

6.4.3 Process decomposition

Since the eTOM framework only provides the processes until Level 3, there is a space for us to create the Level 4 processes in a more specific and concrete manner. To identify Level 4 processes we have adopted the latest drafts of the TMF working groups inside the document of detailed description of Level 3 processes. According to the requirement of our scenarios, we focus on the specific processes in Level 2 for decomposition: Customer Interface Management, Order Handling, Problem Handling and Service Problem Management.

As for the Use Case 1 dealing with customers' subscription, the Customer Interface Management and Order Handling processes are appropriated to implement it.

The other use case, about the management of user's complains, is able to be accomplished with Problem Handling and Service Problem Management. All the decompositions are showed with the framework navigation in ArcheTOM. The diagrams illustrate the hierarchical architecture for decomposition. As the Table 1 shows below, to specify the scenarios separately, there is text edition to demonstrate the hierarchical decomposition until Level 4:

<u>ArchiTelco Business Model</u>			
Level 1	Level 2	Level 3	Level 4
Use case 1			
OPS 1.0 - Customer Relationship Management			
	OPS 1.2 - Selling		
		OPS 1.2.2 - Qualify Opportunity	
		OPS 1.2.4 - Acquire Customer Data	
		OPS 1.2.6 - Develop Sales Proposal	
	OPS 1.4 - Order Handling		
		OPS 1.4.1 - Determine Preorder Feasibility	
			OPS 1.4.1.1 - Determine Product Availability
			OPS 1.4.1.2 - Determine Product Supportability
			OPS 1.4.1.3 - Determine CRM Processes Supportability
		OPS 1.4.2 - Authorize Credit	
			OPS 1.4.2.1 - Initiate Customer Credit Checks
			OPS 1.4.2.2 - Authorize Credit and Credit Terms
		OPS 1.4.3 - Receive PO & Issue Orders	
			OPS 1.4.3.1 - Receive Purchase Order
			OPS 1.4.3.2 - Issue Customer Order
		OPS 1.4.4 - Track & Manage Customer Order Handling	
			OPS 1.4.4.1 - Schedule Customer Provisioning Related Activities
			OPS 1.4.4.2 - Assign Customer Provisioning Related Activities
			OPS 1.4.4.3 - Coordinate Customer Provisioning Related Activities
			OPS 1.4.4.4 - Generate Perspective Service Order
			OPS 1.4.4.5 - Escalate Status of Customer Order
			OPS 1.4.4.6 - Undertake Tracking of Execution Process
			OPS 1.4.4.7 - Add Additional Information to Existing Customer Order
			OPS 1.4.4.8 - Modify Information in Existing Customer Order
			OPS 1.4.4.9 - Modify Customer Order Status
			OPS 1.4.4.10 - Cancel Customer Order
			OPS 1.4.4.11 - Monitor Jeopardy status of Customer Order
			OPS 1.4.4.12 - Escalate Customer Orders
			OPS 1.4.4.13 - Indicate Completion of Customer Order
	OPS 1.7 - Customer Interface Management		

Figure 13: Sample of decomposition of level-3 into level-4 processes

6.4.4 Process flow diagram

Process decompositions have provided an essential insight into the process definition and content. To understand further how the processes act, process flows can be developed to examine how some or all of the processes support some larger view across the enterprise [4]. They can have any scope that is considered meaningful and helpful to analyze. In this project we aim at describing the end to end process flows to represent the selected scenario and its two use cases [5].

Due to the Level 4 processes distributed in its Level 3 processes are relatively in sequence, we do not describe more details of Level 4 processes in the process flow diagrams. In the following we present the process flow corresponding to use case 1.

Use case 1:

Brief description:

The customer is using the URL and contact of MEDIA to subscribe for a set of content services supplied by MEDIA.

Pre-conditions:

The subscriber has a credit card.

The subscriber logged in successfully

Post-conditions:

The online subscription procedure terminated normally.

The subscription succeeded.

Relevant processes in eTOM framework:



Figure 14: Relevant Level 2 Processes of use case 1

6.5 Conclusions

The TMF claims that eTOM is a common structure to define and share business processes within the telecommunications industry. Being a relevant part of the NGOSS architecture, it appears as a quite huge set of documents containing definitions of processes at different hierarchical levels, as well as best practice rules on how to use them. Implicitly or explicitly,

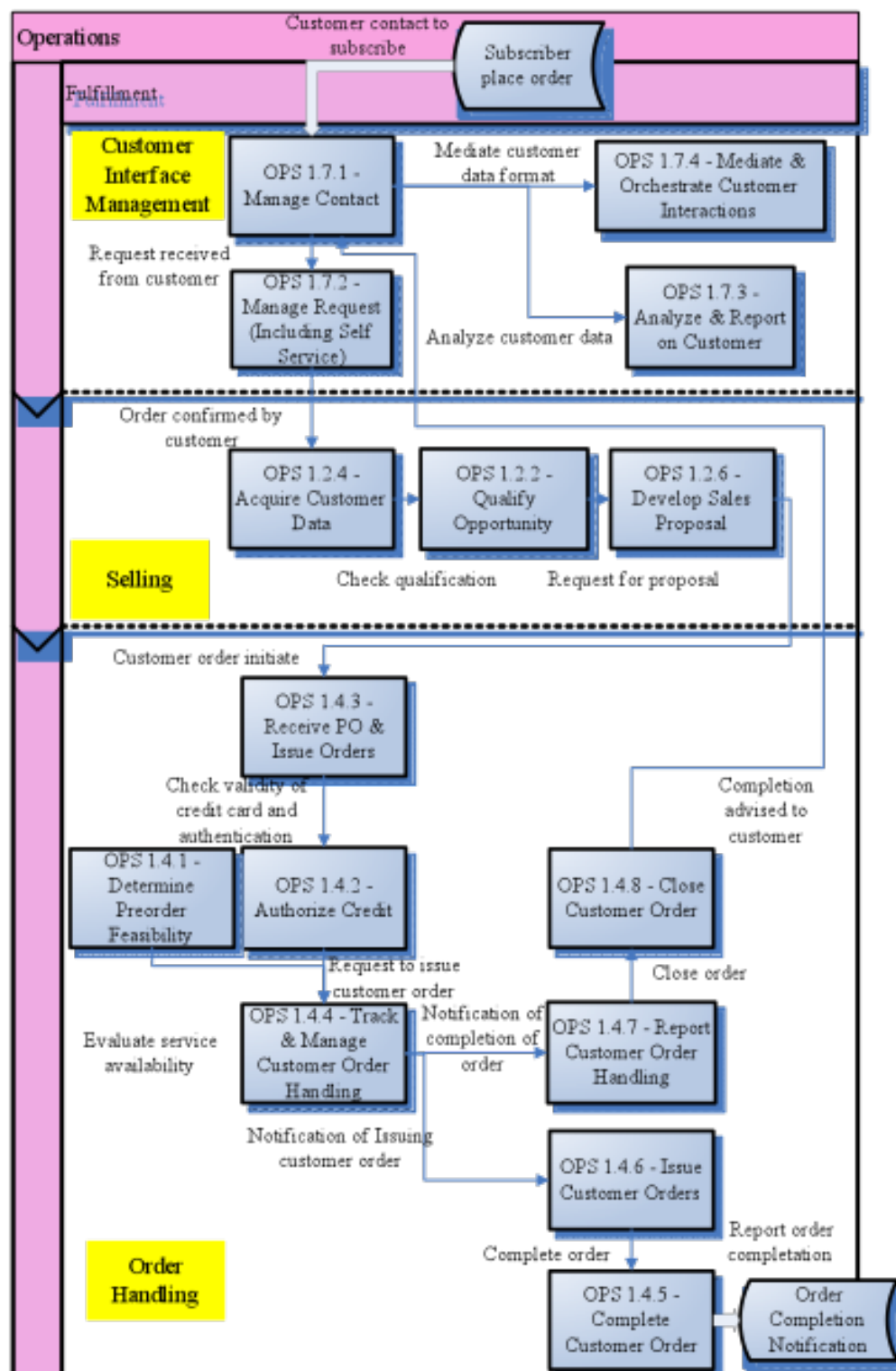


Figure 15: Process flow diagram of use case 1

eTOM assumes that service providers, manufacturers and other stakeholders run their companies with their own business processes architecture. That proprietary architectures are undoubtedly incompatible, both in terms of the syntaxes and the semantics of the entities (business processes) they deal with. Thus a complex scenario is depicted if these

companies have to interact to reach their own goals. Therefore, the adoption of a common structure like eTOM would be beneficial for everybody and the TMF tries to ease this adoption in terms of rules and guidance contained in the set of documents that constitute the standard.

To reach our objectives we adopted a methodology consisting in a thorough study of the set of documents where eTOM is grounded, a search of the current commercial development and support tools and the specification of a scenario with the intention to apply eTOM to the contexts there defined.

From the specification of the business processes applicable to the selected scenario we can highlight several facts. First of all, the importance to properly select a deployment structured in different implementation priorities. Otherwise, the effort is tremendous and the risk of adopting wrong decisions higher. In that line we considered as first priority processes a subset of the Fulfillment and Assurance areas, because without those processes is really apparent that the service provider can't start its business. More specifically we developed Order Handling and Problem Solving. For these groups of processes we adopted the framework up to Level 3 according to the current set of TMF documents and decomposed the Level 3 processes into Level 4 according to particular needs of our sample service provider company. At this point it is worthy to say that, due to the size of the company and its product portfolio, we don't consider to go further decomposing Level 4 processes into Level 5 ones. Having a too much fine grained decomposition would create more management complexity that would not be compensated by any additional clarification. For this reason our particular choice in this case is to stop the specification process at Level 4.

Another fact to highlight is about the specification methodology of the Level 4 processes. We took as a reference existing ongoing TMF work on processes decomposition at level 4 and for each of these candidate processes we decided whether it was or not appropriate to instantiate it for our service provider. The starting point to take the decision was the definition of these provisional works and our own conception about our target service provider. Here we have to say that even at Level 4 the processes that TMF is working on are rather generic and sometimes difficult to understand from the accompanying documentation. On the other hand, our own understanding of the business needs of the service provider company was quite elementary and therefore these were not aiding too much to interpret the above mentioned generic processes. For future work we propose to dig more in the area of the real business needs of a company and not only base the decision on the definition of generic processes. This business needs could be collected by means of questionnaires designed for that purpose.

The material produced within this project will be used in the Merit Master module entitled Communications Network Management Technologies [6] that will be given in Spring 2010 at UPC.

7 Conclusions

Most of the WP1 activities supported in the third and last phase of EMANICS were continuations of the previous years. Wrt. common course program activities, EMANICS started by examining courses offered by all partners, collected course material and created new where appropriate. A model European Master level program has been defined, challenges and requirements on a PhD level program have been collected. In addition, EMANICS partners have created course material on the topics:

- Economic Management - Charging and Accounting of IP Services
- Advanced Topics - Policy-based Management, Context-awareness and Ontologies in Network and Service Management
- Advanced Topics - A Practical Approach to the Operation of Telecommunication Services driven by the TMF e-TOM Framework

Last not least, first steps towards a modern text book on network and service management reflecting the various experiences of 10 European countries were made.

The integration between EMANICS partners has continuously improved; this is not only a matter of countable events but also the quality. For example, it changed from a higher number of work package meetings in the beginning of the project to an increasing number of research visits among EMANICS partners where one specific topic is in the center of interest. Also, the number of co-organized events has increased dramatically. In WP1, we developed the EMIN tool to illustrate EMANICS integration with different metrics, it is available as a Web application.

Similarly, the *worldwide research map* (available as Web application) provides information about research activities in the area of network and service management and can especially output data for the EMANICS involvement in international conferences and workshops, the popularity of specific research topics, and link to the SNP LinkedIn.

8 Acknowledgement

This deliverable was made possible due to the large and open help of the WP1 Partners of the EMANICS NoE. Many thanks to all of them.

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